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Analysis of the Policy Effect of "Automobile Go to Countryside" and Relative Suggestions

Xinxin Zheng[1]

[1]*Business School, Beijing Normal University, Beijing 100875, China*
[*]*Corresponding author. Email: 201711030439@mail.bnu.edu.cn*

ABSTRACT

From 2008 to 2010, the Chinese government launched an "Automobile Go to Countryside" policy to encourage residents in rural areas to purchase vehicles with a displacement of 1.3L or less. I evaluate the effect of this policy on car sales using the difference-in-differences design that combines differences across time and car sizes. The estimates suggest that sales volume of cars with displacements less than 1.3L sold after the policy increase by approximately 16.09% relative to cars with displacements larger than 1.3L. Furthermore, the heterogeneous effects of this policy suggests that the resident's ownership of cars, changes in oil prices and related manufacturers will also play a positive or negative role in the effect of the policy.

Keywords: *vehicle policy, incentives, consumer awareness*

1. INTRODUCTION

Since the Reform and Opening-up policy in 1978, China has formally established a market economy system. With the help of transnational trade, China's labor-intensive industries have grown rapidly, driving China's GDP to grow at a rate of more than 10% for more than 35 consecutive years. However, with the rapid development of China's economy, labor costs have also risen. Therefore, as a large number of labor-intensive enterprises turn to Southeast Asian countries with lower labor prices, China's slowdown in GDP growth has become inevitable. In recent years, in order to prevent China from falling into the so-called "middle-income country trap", the government has launched a series of policies to expand consumption and boost domestic demand. Among them, the automobile industry, as a leading industry with a slower development rate, has received particular attention from the state and the government.

At the beginning of the 20th century, automobiles were still a relatively high-class durable consumer product with a relatively low ownership rate among Chinese households. With the continuous improvement of the income level of residents and the Chinese government's policy to encourage cars to enter households, especially the relaxation of price controls on manufacturing companies in May 2001, cars have gradually become a more common consumer product for ordinary households. Nowadays, although China has become the world's largest automobile producing and consuming country, the automobile industry is large but not strong, and it lacks the world's leading independent auto brands. What's more noteworthy is that after years of rapid development, China's auto market has entered a stage of low-speed growth. In 2018, the Chinese auto industry, which has been growing for more than 20 years, has begun to stagnate.

At the same time, there are many auto companies in China, and market competition is fierce. In this context, after the domestic leading car companies gaining shares in the domestic market, they will increase their efforts to explore the international market, while small car companies will launch a market sinking policy and seek a way to survive in less developed regions. In 2018, the outbreak of the Sino-U.S. Trade war has caused huge losses to auto companies on the international road, while small car companies have gained a fortune in the rise of less developed cities.

Therefore, on 20.01.2019, ten ministries including the National Development and Reform Commission and the Ministry of Finance jointly issued an implementation plan to further optimize supply, promote the steady growth of consumption, and promote the formation of a strong domestic market. Measures relevant to car purchases for rural residents, new energy vehicles, and second-hand car transactions for small-displacement vehicles have been introduced to promote consumption. The plan mentions "to promote the upgrading of rural vehicles. If conditions are met, it's possible to give appropriate subsidies for rural residents to purchase trucks of 3.5 tons or less or passenger vehicles of 1.6 liters or less." It was regarded as a new round of "Automobile Go to Countryside" after 2009. Subsequently, nearly 30 brands such as FAW-Volkswagen and Dongfeng Nissan responded and launched a series of subsidy policies, including cash subsidies, financial interest subsidies, zero-interest loans, etc., hoping to take this opportunity to boost sales.

Although the two policies are both to promote consumption, the current Chinese auto market is not comparable to a decade ago, no matter in new car sales, market holdings or rural market development. Moreover, the vast rural areas have completed the initial market cultivation of automobile consumption. The first wave of purchasing has already eliminated the purchasing power of farmers. According to Barwick et al. (2017), one unique point of Chinese automobile market to study brand preferences is that most vehicle buyers are still first-time buyers. In the overall

economic downturn, the grand occasion of ten years ago has been difficult to reproduce. Simultaneously, many people doubt that the policy in 2019 is not strong enough. In the "Automobile Go to Countryside" policy launched in 2009, 80% of the subsidy funds came from the central government, and the rest were undergone by the provincial finance. However, in 2019, the decision-making power of subsidies was placed in the hands of car companies, and the price difference caused by subsidies will also be entirely the responsibility of the car companies.

Judging from the current subsidies that have certain thresholds, it is more like a promotion campaign to absorb backlogs and handle backward production capacity in the name of the "Automobile Go to Countryside" policy. In order to investigate the legitimacy of these questions, the paper evaluates whether the 2009 "Automobile Go to Countryside" policy indeed played a role. Furthermore, I examine the heterogeneous effects to understand what factors affected the implementation of the "Automobile Go to Countryside" policy from 2009 to 2010.

I use the data that contain car sales from 2008 to 2010 for each province in difference-in-difference research design to understand the effect of "Automobile Go to Countryside" policy. Since the policy only applied to small cars, I regard the small cars as a treatment group and large cars in the same period as the control group. The research design exploits the change in the sales of small cars relative to the sales of large cars after the policy implementation.

First, I estimate that the "automobile to the countryside" increases small car sales by 16 % relative to large cars; the policy indeed promoted the purchase of small cars. Next, to further understand the policy effects, I explore the heterogeneous effects of the policy depending on car ownership, oil price, and manufacturers.

I find that the sales of small cars in low-ownership provinces increase by about 18.6% compared with the sales of large cars after the policy, while the sales of small cars in the other provinces only increase by 13.6%. I define car ownership using the proportion of small cars in total car sales and classify half of the provinces with an ownership rate of more than 15% as the provinces with the most possession, while the provinces with an ownership rate of less than 15% are called provinces with low stocks. The results suggest that the policy effects significantly depend on car-ownership.

Furthermore, I examine the heterogeneous impacts of the policy depending on oil prices. The results suggest that the policy effects are larger during the time when oil prices are low; the level of oil prices has an insensitive but obvious effect on consumer behavior. Using the median numbers of the gaps in a certain province between each price and the average oil price from 2008 to 2010 as the standard to define the oil prices, I find that the sales of small cars relative to large ones increase by 23.5% after the implementation of the policy during the low-price time, while the sales increased by 18% during the high-price time. However, after the redefinition that viewing the oil price with the highest 25% gap as high oil price, while viewing the ones with the lowest 25% gap as low oil price, I find that the sales of small cars relative to large cars increase by 26% during the low-price time, and increases by only 6% during the high-price time.

Finally, I examine the brand-level sales changes and find that the sales of small cars from Zhonghua, Geely Global Eagle, Chery Kerry, and Suzuki significantly increase; the manufacturers benefit more due to their rapid response to the policy. The results give implications for manufacturers who may benefit from the next-round policy.

1.1. Related Work

The study is related to several lines of research. I discuss each of them below.

1.1.1. The impact of financial incentives on vehicle adoption.

Large body of literature mainly focuses on consumers' choice of consumption of EVs and show that the use of electric vehicles is closely related to fiscal policy or monetary incentives in various countries. For instance, in Norway, named as the "capital" of EVs, Aasness and Odeck states that the obvious increase of EVs is due to multiple economic incentives [1]. Measures such as exemption from toll charges, exemption from purchase duties and permission to use transit lanes have all functioned to induce road users to purchase and use EVs. For the European countries, Ryan et al investigate the impact of national vehicle and fuel taxes on new car sales, focusing on CO2 emission intensity in EU15 over a 10-year period. Their results indicate that an increase in diesel vehicle circulation tax can also cause the petrol vehicle share and the CO2 emissions to increase [2]. In addition, an increase in petrol circulation taxes of 10% can cause a short term decrease in fleet CO2 emissions of 0.3g per km in the short run and 1.4g in the long run. For the US market, Clinton and Steinberg estimate the impact of vehicle rebate incentives between 2011 and 2015 on battery electric vehicles (BEVs) purchase. They implement the difference-in-differences design by using state-level variations in financial incentives. They found that an incentive of $1,000 increases BEVs purchase by 8 percent [3]. However, responses do not differ significantly by the make of the vehicle purchased and the state income credits do not have an obvious impact on BEV adoptions on a statistical scale. Jenn et al. also found that every $1000 offered as a rebate or tax credit increases the average sales of electric vehicles by 2.6% [4]. Some work also investigate hybrid vehicles; Gallagher and Muehlegger found evidence that both the generosity and type of incentive influence consumer behavior [5]. To be more specific, Beresteanu and Li concentrate on gasoline prices and income tax incentives. Hybrid vehicle sales in 2006 would have been 37% lower had gasoline prices stayed at the 1999 levels, and the effect of the federal income tax credit program is estimated at 20% in 2006. Under the program, the cost of reducing gasoline

consumption was $75 per barrel in government revenue and that of CO2 emission reduction was $177 per ton [6].

It is worth noting that the United States has also implemented a policy similar to "Cars go to the countryside" at the same time-- “Cash-for-Clunkers”, also known as the Car Allowance Rebate System (CARS). “Cash-for-Clunkers” was a $3 billion program that started in July 2009 to stimulate the US economy and improve the environment by encouraging consumers to retire older vehicles and purchase fuel-efficient new vehicles. However, past work find that the program was not efficient enough. Using Canada as the control group, Li et al. found that, of the 0.68 million transactions that occurred under the program, the program increased only 0.37 million of them during July and August of 2009. In other words, approximately 45 percent of the spending went to consumers who would have purchased a new vehicle anyway [7].

As for Canada, the government has also launched tax rebates policies in 2000 to promote the sales of HEVs. Past work also find that the implementation did not receive the expected result. Chandra et al. (2009) indicate that the hybrid tax incentives in Canada are possibly not the most effective way to encourage people to switch away from fuel-inefficient vehicles like large SUVs or luxury sport passenger cars, at least in the short or medium run [8]. Similar to the case in America, their result shows that these programs primarily subsidize people who would have bought hybrids or fuel-efficient cars in any case. Moreover, Diamond put forward that provide payments upfront is also an effective measure [9].

1.1.2. Other factors that can influence vehicle adoption.

In addition, there are also studies working on the effect of oil prices on car sales. Klier and Linn have found that the price of gasoline has a significant effect on vehicle model sales. Controlling unobserved characteristics by using monthly sales and gasoline price data, they estimate that much of the fluctuation in the market share of large SUVs and of US automakers from 2002 to 2007 could be explained by the price of gasoline [10]. In particular, Gallagher and Muehlegger appraise that a $100 increase in annual fuel savings is connected with a 13% increase in hybrid vehicle sales. By comparing the demand for sales tax relief on fuel economy, they estimate that early hybrid vehicle adopters implied a 14.6% discount rate on future fuel savings [5]. However, even the gasoline price is also relevant to the country-level financial situation, its effect on consumers can be quite different from other monetary elements. Diamond suggests that hybrid adoption is strongly linked with gasoline prices, but is more weakly connected with other incentive policies [9].

For non-monetary incentives, Jenn et al. found that HOV lane access is a significant contributor to adoption with the effect that a 4.7% increase corresponds to the density of HOV lanes every 100 vehicles per hour [4]. However, in the work of Gallagher and Muehlegger, only the HOV program offered by Virginia is estimated to be positively correlated with hybrid sales. Although they found the estimated effect to be quite large, the magnitude of the effect decreases after Virginia limited access to HOV-3 lanes during rush hour [5].

1.2. Our Contribution

The above-mentioned results suggest that state policies can substantially affect hybrid vehicle purchases at the state-level, from which we can see that most of the previous researches have focused on the promotion of electric vehicles and their impact on the environment, while this paper contributes to this topic by looking at the adoption of traditional vehicles. From a different perspective, I focus on the effect of classic vehicle adoption instead of BEVs adoption. At the same time, I have innovatively selected China's rural automobile market as the research subject and noted the possible impact of regional imbalanced development on it.

1.3. Paper Structure

The rest of the paper is organized as follows. Section 2 introduces the background of the implementation of the policy of automobiles going to the countryside in 2009, which also contains a descriptive introduction to the data I use. Section 3 is to explore the function of the “Automobile Go to Countryside” policy, while Section 4 is to explore the impact of changes in ownership, oil prices, and automobile manufacturers on the effectiveness of this policy. Finally, Section 6 concludes the paper and presents direction for future research.

2. BACKGROUND & DATA

In 2009, the “Automobile Go to Countryside” policy was launched by the Chinese government throughout the country. This is one of the largest car sales promotion policies in the 21st century. I discuss the background of this “Automobile Go to Countryside” policy and the data used in this analysis in this section.

2.1. “Automobile Go to Countryside” in 2009

To cope with the global financial crisis impact on China’s automobile industry as well as expand the domestic demand and stabilize the automobile consumption, in early 2009, the State instituted and implemented the policies that farmers who buy automobiles sold in the countryside can get an allowance.

From March 31, 2009, to December 31, for farmers who have purchased mini buses and motorcycles with

displacements of 1.3 L or lower, a financial subsidy of up to 5,000 yuan will be granted. To ensure the effective implementation of the policy, in early 2010, seven ministries including the Ministry of Finance and the National Development and Reform Commission jointly issued a notice to extend it for one year until 31.12.2010. As for the result of the policy in 2009, the actual sales situation shows that "Automobile Go to Countryside" policy has functioned greatly, which are reflected in the following aspects:

2.1.1. promoted the production and sale of cars

Since the outbreak of the US financial crisis, China's automobile sales have continued to decline, with negative growth for five consecutive months from August 2008 to January 2009. Since January 2009, driven by many favorable policies such as "Automobile Go to Countryside", the auto market has begun to pick up. The monthly sales of cars have exceeded 1 million units in a row, and the performance of minibusses is even more gratifying. In 2009, the market of mini buses, minivans and light trucks increased dramatically. Among them, the sales volume of mini buses reached 1,595 million with an increase of 83.39% year-on-year; the sales volume of minivans was 505,700 with an increase of 70%; the number for light trucks was 1.5596 million, with an increase of 30%. The above three models achieved a net increase of more than 1.5 million vehicles in 2009, and the growth rate was significantly faster than the overall level of the automobile, contributing to 34% of the national automobile sales increase. In a nutshell, the policy plays a role in expanding automobile consumption and stimulating economic growth.

2.1.2. improved farmer ' s production and living conditions and stimulate domestic demand

With the improvement of farmer's income and rural road conditions, most farmers have the ability to buy low-priced micro and light vehicles. The "Automobile Go to Countryside" policy is like a catalyst, stimulating farmers' car purchases, improving farmers' production and living conditions, and accelerating rural consumption upgrades. In 2009, light trucks replaced at least the market production and sales of more than 350,000 agricultural vehicles, which effectively promoted the upgrading of rural transportation.

2.1.3. promoted the development of the automobile industry and the adjustment of industrial structure

The expansion of the rural market has brought a revolutionary impact on the development of China's automobile industry. Not only has the market scale increased sharply, but also the development path, product structure, production, and sales network of the automobile industry have undergone major changes. According to previous research, benefiting from "Automobile Go to Countryside" and various preferential policies, domestic mini vehicles sales volume surged 74% year on year in 2009, making itself the fastest growing market segment. The sales contribution of mini vehicles directly determines the ranking of domestic car companies. SAIC and Changan Automobile group have achieved the leading position in the first and fourth sales charts due to the help of micro-cars.

The upgrade of rural car consumption models has also prompted auto manufacturers to adjust their product structure and eliminate background production capacity. Under the direct influence of this policy, enterprises producing three-wheeled vehicles and agricultural vehicles must gradually switch to mini-cars. If the transformation is unsuccessful or cannot be transformed, it will be eliminated by the market. The subsidy of the policy is mainly for mini-cars, and passenger cars with a displacement of 1.6 or less will enjoy a halving of the purchase tax. Therefore, in the first half of 2010, the market share of 1.6 and below liter displacement vehicles has risen to 68.55%. The small-displacement car market is on the rise. Researchers believe that the "Automobile Go to Countryside" policy not only is an intentional measure to deal with the financial crisis but also has its profound guiding significance. In terms of rural road conditions, farmers' income, living standard, and China's energy situation, mini-vehicles and small-displacement vehicles should be the inevitable trend in the future development of China's auto industry structure.

2.1.4. extending the automotive industry chain

"Automobile Go to Countryside" policy is not only about the entry of cars, but also about the improvement and expansion of rural roads, the establishment of automobile sales outlets, the entry of after-sales service(such as gas station, maintenance stations, car beauty stations), the extension of the automobile insurance and auto finance industry, the establishment and expansion of the logistics industry, the training of automobile driving and the handling of driver's license, etc. At the same time, the automobile manufacturers go to the countryside, the car services follow. In this way, the "Automobile Go to Countryside" policy has promoted the geographical extension of China's automobile industry chain.

However, the above explanation does not mean that the policy has no flaws. There are still many problems that appeared at that period, which are also possibly the reason why the policy in 2019 could not achieve the same success. For example, with the implementation of the "Automobile Go to Countryside" policy, the problem of insufficient after-sales service in the rural market has gradually been exposed. The service problem has become a bottleneck restricting the further advancement of the policy. Relevant policies stipulate that automobile suppliers should provide reliable and cost-effective products for customers. However, the automotive after-sales service market is still in the early stage of development, far from perfect. Complaints about the after-sales service problems in the second- and third-

class automobile market are endless, including the scarcity of maintenance outlets, low maintenance levels, and an insufficient supply of spare parts.

2.2. Data

The data I used is from an administrative dataset from China's Traffic Administration Bureau, Ministry of Public Security. Other work have used datasets similar to my study to study the factors affecting the Chinese automobile market, such as local protectionism and historical factors. According to Barwick et al., local protectionism results in 18.7 billion yuan of consumer welfare loss, amounting to 40% of the total subsidy [11]. While for Chen and Zhang, their research shows that after the Sino-Japanese conflict in 2012, Japanese car sales in some Chinese areas invaded before by Japan were lower than in other regions by 8.5% and the effect could last over 24 months, indicating the intergenerational transmission of memories [12].
The dataset is aggregated at the car sales model-market-day level from 2008-2010 for all mainland China. For example, each line of the data has the record that there were 73 BMW 730Li cars(3.0L engine) registered in Zhejiang Province on April 1st, 2008. In 2008, the data have 797,184 model-market-day level observations, recording registration for 5,333,963 vehicles. While for 2009, aggregate sales reached 8,018,942. Sales figures for the 31 provincial auto markets are included, and they are divided into 120 brands.

Table 1. Data description and summary statistics

	mean	sd	min	max
year	2009.00	0.82	2008.00	2010.00
month	6.50	3.45	1.00	12.00
Amount	9.99	64.03	0.00	5118.00
lnamount	0.53	1.23	0.00	8.54
treat	0.08	0.27	0.00	1.00
Observation	2391552			

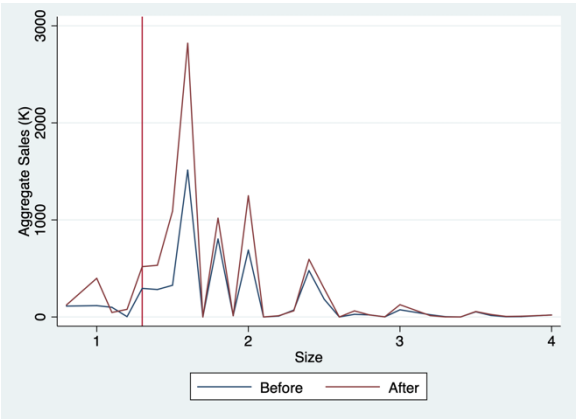

Figure 1a Sales across Sizes

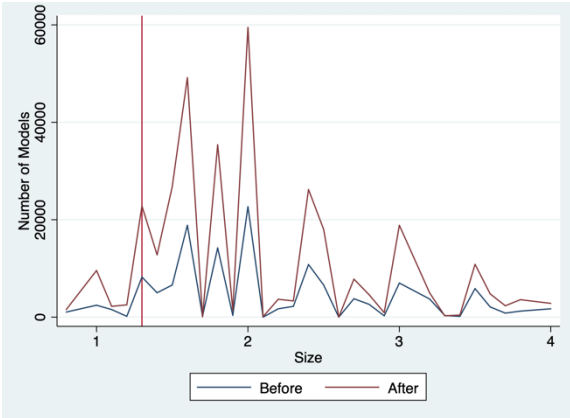

Figure 1b Number of Models across Sizes

Figure 1a plots the aggregate sales across sizes for pre-period (2008) and post-period (2009--2010), respectively. To make the two periods comparable to yearly sales, I divide the aggregate sales by 2 in the post-period. The figure suggests that most people buy larger cars. In addition, consumers buy more not only small cars, but also large ones after the policy; this suggests that there are unobserved demand-side factors in the car demand.
Figure 1b, in which the number of models in the post-period is also divided by2, plots the number of models across sizes for pre-period (2008) and post-period (2009--2010), respectively. Each model is defined as a model-market level. In other words, each model in a market counts for a model. The figure indicates that more and more models are being introduced, especially the models for small cars. This suggests a supply-side response -- manufacturers may introduce more models in response to higher demand.

3. IDENTIFICATION STRATEGY

To evaluate the effect of this policy on car sales, I use the differences-in-difference approach that combines differences across the sizes of cars with differences whether cars are sold before or after the policy launching. I explore the policy variation that the policy only affects small-displacement cars (<1.3L). Large displacement cars are used as the control group that controls the unobserved factors that change the car sales volume for both small and large displacement cars; these factors include macroeconomic events such as the 2008 financial crisis or the common market trend that is constant across the treatment group and control group.
I perform the difference-in-differences analysis using the following specification:

$$\log S_{ijt} = c + treat_j + after_t + treat_j * after_t \qquad (1)$$

where c is a constant, S_{ijt} indicates the car sales of market i for product j at month t, $treat$ is a dummy variable for whether product j is a small car, while $after$ is an indicator whether month t is after 2008 (after the implementation of this policy). The coefficient of interest is $treat_j * after_t$, which measures change in the log of sales

for small cars relative to the large cars before and after the policy "Automobile Go to Countryside". In other words, this measures the treatment effect of this policy on small car sales. Note that the regression results presented in the paper, all the standard errors are clustered at the market level. The reason to use the cluster is to prevent the possible statistical problems caused by repeated observation in the panel data, since the car sale in one month is usually serially correlated. The clustering could prevent underestimating the standard error due to the serial correlation.

The key assumption behind the difference-in-differences model is that whether there is a common time trend of car sales across the treatment group and the control group. I first verify this by plotting the average of logarithm car sales over time separately for these two groups in Figure 2.

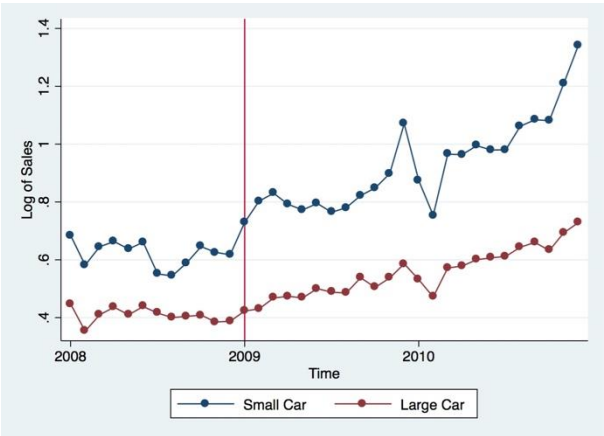

Figure 2 Monthly Average of Logarithm Car Sales

Figure 2 shows the evolutionary trend of the monthly average of logarithm car sales amount across markets from Jan.2018 to Dec. 2010. The vertical red line indicates the time when the "Automobile Go to Countryside" policy was implemented. The average log car sales for small cars have always been higher than for the large ones after the implementation; the gap between the two has been significantly expanded after the launch of the policy. I then run a regression to formally investigate whether the common trend assumption holds. The specification is as follows:

$$\log S_{ijt} = c + treat_j + treat_j * after_t * Firm + Month_{FE} + Market_{FE} \quad (2)$$

Equation (2) is very similar to Equation (1). The only difference is the interaction with time to measure the average treatment effect per month. In this way, I can see the changes before and after the policy dynamically. It is worth noting that the car sales dropped sharply from July to September in 2008, resulting in a part of the line in Figure 2 below 0. And unfortunately, I have not found suitable facts or theories that could explain this change.

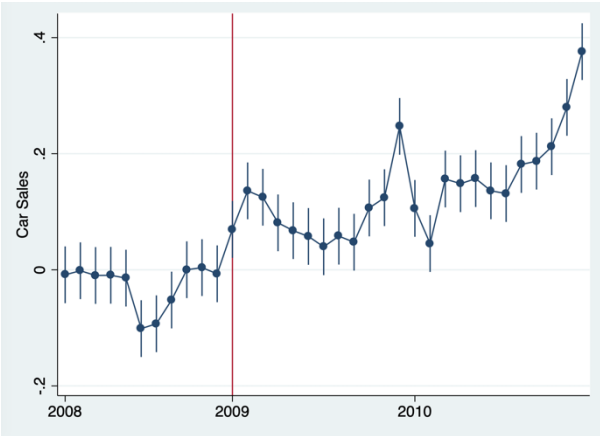

Figure 3 The Gap of Car Sales between Large and Small Cars

The coefficients describe the change in the gap between the sales volume of large and small cars compared to the initial value, through which I could know whether there is a constant gap between the sales to check the pre-trend. I can investigate that before the policy is implemented, the sales of big cars and small cars in the line chart (Figure 2) are parallel. In a more intuitive way, in Figure 3, before the policy is implemented, the line representing the gap will be close to 0. With the gradual landing of the "Automobile Go to Countryside" policy, the line will gradually deviate from the x axis, which means that the gap is by degrees widening. Figure 3 suggests that the parallel pre-trend assumption holds.

4. EMPIRICAL RESULTS

I first investigate whether the policy plays a role in encouraging the consumption of small-sized cars using Equation (1). Table 2 shows the estimates from Equation (1). Note that the coefficient of interest is treat*after, which measures the impact of log sales on small cars relative to the large cars.

Table 2. Difference-in-Differences Results

```
. reg lnamount 1.treat 1.after 1.treat#1.after, cluster(marketg)

Linear regression                               Number of obs     =  2,391,552
                                                F(3, 31)          =     122.77
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0085
                                                Root MSE          =     1.2292

                                   (Std. Err. adjusted for 32 clusters in marketg)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.2125225	.0297156	7.15	0.000	.1519172	.2731278
1.after	.143399	.0087555	16.38	0.000	.125542	.161256
treat#after						
1 1	.1609316	.0144087	11.17	0.000	.1315447	.1903184
_cons	.4078992	.0313613	13.01	0.000	.3439374	.4718609

	equation1	
treat=1	0.213***	
	(0.005)	
after=1	0.143***	
	(0.002)	
treat=1 # after=1	0.161***	
	(0.006)	
Constant	0.408***	
	(0.001)	
Observations	2391552	
Adjusted R-squared	0.009	
Standard errors in parentheses		
="* p<0.05	** p<0.01	*** p<0.001"

The estimates in Table 2 suggest that the "Automobile Go to Countryside" policy led to an increase in small car sales after the policy. Cars with displacements less than 1.3L sold after January of 2009 has approximately 16.09% higher sales volume.

I further add more controls to control for market fixed effects and monthly fixed effects. The market fixed effects control the unobserved market-specific sales that are constant across time. The monthly fixed effects control the unobserved time trend that are constant across markets. In this specification, $after_t$ is absorbed by monthly fixed effects. Table 3 reports the results with market fixed effects and monthly fixed effects. The estimates after the controls suggest that cars with displacements less than 1.3L sold after January of 2009 has approximately 18.57% higher sales volume. The results are comparable when controlling for fixed effects, suggesting that the results of difference-in-differences are not sensitive to unobserved market-specific sales and time trend.

Table 3. Difference-in-Differences Results with Fixed Effects

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.1324252	.0399781	3.31	0.005	.0472138	.2176366
1.after	0	(omitted)				
treat#after						
1 1	.1857353	.0176516	10.52	0.000	.1481118	.2233588
_cons	.6064	.0036237	167.34	0.000	.5986762	.6141239

Absorbed degrees of freedom:

Absorbed FE	Categories	- Redundant	= Num. Coefs	
monthlyfix	36	0	36	
market	16	16	0	*

* = FE nested within cluster; treated as redundant for DoF computation

.
end of do-file

Through the above exercises, I find that the policy of "Automobile Go to Countryside" has a significant positive effect on the growth of small car sales. The next steps are to explore what factors have contributed to or hindered the effectiveness of this policy during this role. I discuss my findings below.

4.1. Heterogeneous Effect: Car Ownership

The first factor I explored is car ownership. Intuitively, the higher the car ownership, the fewer people are willing to buy a new vehicle. However, it is worth noting that I cannot simply use the sales volume of cars as an indicator to measure the amount of ownership in a certain market, because each province has significant differences in other aspects such as population size or economic development level. For example, the total population of Henan Province exceeds 100 million, while the Tibet Autonomous Region has only 3.18 million. Considering that these factors as endogenous variables will make my results inaccurate, I use the proportion of small-sized cars to the total car sales to measure the ownership level of small cars.

After calculating the proportion for each market, I find that: Firstly, nationally, small cars accounted for an average of 13% of the province's total car sales. Secondly, the markets differ greatly. The lowest proportion of small cars is 1.3%, while the highest is 24%.

Taking into account that the median is about 15%, I classify the provinces with car ownership rates greater than half of 15% as the provinces with the highest holdings, while provinces with less than 15% are called provinces with low inventory.

I examine Equation (1) separately on the sample with higher and lower car ownership rates (splitting by the median), controlling for market fixed effects and monthly fixed effects. Table 4 and 5 report the coefficient estimates for high and low car ownership, respectively.

Moreover, the results show that compared with the sales of large cars, the sales of small cars increased approximately by 18.6% in the provinces with low ownership, and only 13.6% in the provinces with high ownership after the implementation of the policy. The difference in the treatment effect is statistically significant for markets with higher and lower car ownership.

Table 4. Difference-in-Differences Results Conditional On High Car Ownership

HDFE Linear regression — Number of obs = 1,195,776
Absorbing 2 HDFE groups — F(2, 15) = 36.27
Statistics robust to heteroskedasticity — Prob > F = 0.0000
R-squared = 0.0465
Adj R-squared = 0.0464
Within R-sq. = 0.0094
Number of clusters (market) = 16 — Root MSE = 1.0619

(Std. Err. adjusted for 16 clusters in market)

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.2926199	.0345863	8.46	0.000	.2189008	.3663389
1.after	0	(omitted)				
treat#after						
1 1	.1361279	.0215533	6.32	0.000	.0901881	.1820676
_cons	.400597	.003602	111.22	0.000	.3929196	.4082744

Absorbed degrees of freedom:

Absorbed FE	Categories	- Redundant	= Num. Coefs	
monthlyfix	36	0	36	
market	16	16	0	*

Table 5. Difference-in-Differences Results Conditional On Low Car Ownership

```
HDFE Linear regression                            Number of obs   =  1,195,776
Absorbing 2 HDFE groups                           F(   2,     15) =     59.06
Statistics robust to heteroskedasticity           Prob > F        =    0.0000
                                                  R-squared       =    0.0275
                                                  Adj R-squared   =    0.0275
                                                  Within R-sq.    =    0.0029
Number of clusters (market)  =          16        Root MSE        =    1.3400

                              (Std. Err. adjusted for 16 clusters in market)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.1324252	.0399781	3.31	0.005	.0472138	.2176366
1.after	0	(omitted)				
treat#after						
1 1	.1857353	.0176516	10.52	0.000	.1481118	.2233588
_cons	.6064	.0036237	167.34	0.000	.5986762	.6141239

Absorbed degrees of freedom:

Absorbed FE	Categories	- Redundant	= Num. Coefs	
monthlyfix	36	0	36	
market	16	16	0	*

* = FE nested within cluster; treated as redundant for DoF computation

The results are consistent with our intuitive assumptions, which, however, have also questioned whether the new round of car-to-rural policies in 2019 could achieve results. Ten years ago, China's car ownership was 76 million, and the annual car sales were only 938,500, and there is still considerable room for growth. After 10 years, China's car ownership has reached 240 million, and annual sales have reached 28.081 million. With the development of the automobile market, it is not in the stage of high growth anymore but has turned to the stock competition. My results imply that simple consumer incentives may be difficult to make a big impact on the market when car ownership is already high.

4.2. Heterogeneous Effect: Oil Price

I also explore the impact of oil prices on policy effects. However, this raises the question of how to define high and low oil prices. If I analyse the oil prices in a cross-sectional scale, then maybe I am comparing the effects of Beijing and Gansu, instead of the effect of oil prices. Therefore, I explore oil price variations within time across provinces.

Firstly, I calculated the average price of oil in each market over the three years from 2008 to 2010. Secondly, for example to province A, I found the oil prices in different points of time and obtained the gaps between each price and the average oil price in province A. I repeated this step for all provinces. Finally, I calculated the median numbers of these gaps in time scale and used them as the benchmark for measuring the price of oil. In other words, I define oil prices higher than this median as high oil prices, and vice versa as low oil prices.

I run Equation (1) separately on the sample with higher and lower oil prices (splitting by the median), controlling for market fixed effects and monthly fixed effects. I report the estimates in Table 6 and 7 for higher and lower oil prices, respectively.

Table 6. Difference-in-Differences Results Conditional On Low Oil Prices

```
HDFE Linear regression                            Number of obs   =    447,688
Absorbing 3 HDFE groups                           F(   2,     27) =     50.66
Statistics robust to heteroskedasticity           Prob > F        =    0.0000
                                                  R-squared       =    0.0363
                                                  Adj R-squared   =    0.0362
                                                  Within R-sq.    =    0.0066
Number of clusters (marketg) =          28        Root MSE        =    1.1616

                              (Std. Err. adjusted for 28 clusters in marketg)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.1354286	.0384703	3.52	0.002	.056494	.2143632
treat#after						
1 1	.2597268	.0368788	7.04	0.000	.1840577	.3353959

Absorbed degrees of freedom:

Absorbed FE	Num. Coefs.	=	Categories	-	Redundant	
year	3		3		0	
month	11		12		1	
marketg	0		28		28	*

* = fixed effect nested within cluster; treated as redundant for DoF computation

Table 7. Difference-in-Differences Results Conditional On High Oil Prices

```
HDFE Linear regression                            Number of obs   =    395,388
Absorbing 3 HDFE groups                           F(   2,     24) =     57.72
Statistics robust to heteroskedasticity           Prob > F        =    0.0000
                                                  R-squared       =    0.0308
                                                  Adj R-squared   =    0.0307
                                                  Within R-sq.    =    0.0085
Number of clusters (marketg) =          25        Root MSE        =    1.1508

                              (Std. Err. adjusted for 25 clusters in marketg)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.2224775	.03872	5.75	0.000	.1425635	.3023916
treat#after						
1 1	.1980134	.0372798	5.31	0.000	.1210716	.2749552

Absorbed degrees of freedom:

Absorbed FE	Num. Coefs.	=	Categories	-	Redundant	
year	3		3		0	
month	11		12		1	
marketg	0		25		25	*

* = fixed effect nested within cluster; treated as redundant for DoF computation

I find that when the oil price is low, the sales of small cars relative to large cars have increased by 25.9% after the implementation of the policy; when the oil price is high, this number is 19.8%.

It's worth noting that, because the oil price data I obtained through the Choice database are slightly missing in both time and market dimensions, some data was lost during the merge data process, leading to that the result here and the original result do not quite correspond.

However, although the above results are consistent with my hypothesis, these two numbers are not significantly different. In order to further explore the sensitivity of people's reaction to oil prices, I have set stricter high oil price standards, which means, I redefine the oil price with the highest 25% gap as high oil price, while viewing the ones with the lowest 25% gap as low oil price. I run Equation (1) separately on the sample with higher and lower

oil prices (splitting by the highest 25th percentile and the lowest 25th percentile), controlling for market fixed effects and monthly fixed effects.

Table 8. Difference-in-Differences Results Conditional On Low Oil Prices (redefinition)

```
HDFE Linear regression                            Number of obs   =    675,716
Absorbing 3 HDFE groups                           F(   2,     27) =     61.94
Statistics robust to heteroskedasticity           Prob > F        =    0.0000
                                                  R-squared       =    0.0354
                                                  Adj R-squared   =    0.0353
                                                  Within R-sq.    =    0.0079
Number of clusters (marketg) =          28        Root MSE        =    1.1536

                              (Std. Err. adjusted for 28 clusters in marketg)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.1398189	.0316423	4.42	0.000	.0748942	.2047436
treat#after 1 1	.2828489	.0312773	9.04	0.000	.2186731	.3470247

Absorbed degrees of freedom:

Absorbed FE	Num. Coefs.	=	Categories	-	Redundant
year	3		3		0
month	11		12		1
marketg	0		28		28 *

* = fixed effect nested within cluster; treated as redundant for DoF computation

Table 9. Difference-in-Differences Results Conditional On High Oil Prices (redefinition)

```
HDFE Linear regression                            Number of obs   =    167,360
Absorbing 3 HDFE groups                           F(   2,     15) =     50.98
Statistics robust to heteroskedasticity           Prob > F        =    0.0000
                                                  R-squared       =    0.0272
                                                  Adj R-squared   =    0.0270
                                                  Within R-sq.    =    0.0058
Number of clusters (marketg) =          16        Root MSE        =    1.1684

                              (Std. Err. adjusted for 16 clusters in marketg)
```

lnamount	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.treat	.2739111	.0536176	5.11	0.000	.159628	.3881942
treat#after 1 1	.072903	.0635314	1.15	0.269	-.062511	.2083169

Absorbed degrees of freedom:

Absorbed FE	Num. Coefs.	=	Categories	-	Redundant
year	3		3		0
month	11		12		1
marketg	0		16		16 *

* = fixed effect nested within cluster; treated as redundant for DoF computation

Table 8 and 9 shows that, after redefinition, the outcome shows that the sales of small cars relative to large cars have increased by 28% for low prices after the implementation of the policy; when the oil price is high, the effect is not significant and the number is only 7%.

Given the results, I conclude that for higher oil prices, people's response to the policy of "cars going to countryside" will be weaker and vice versa. Moreover, when the prices of oil fluctuate sharply, people would react more strongly to them and the effect of the policy would also significantly change. My results give an implication on whether the consumer incentives would increase car sales and can depend on macroeconomics conditions such as oil prices.

4.3. Heterogeneous Effect: Manufacturers

Lastly, I investigate which manufacturers have achieved rapid growth in small car sales and maximized benefits after the policy of "Automobile Go to Countryside" in 2009 and explore the reasons behind their success. Similar to the previous research, I also use the growth of small cars relative to large cars after the implementation of the policy as an indicator of the performance of manufacturers. I interact the difference-in-differences estimator with manufacturer fixed effects. I also control for monthly fixed effects $Month_{FE}$ and market fixed effects $Market_{FE}$ in the regression:

$$\log S_{ijt} = c + treat_j + treat_j * after_t * Firm + Month_{FE} + Market_{FE} \quad (3)$$

There are total 120 manufacturers in the data, meaning that I estimate the performance for 120 firms using the fixed effects. Among all the manufacturers included in the data, the sales of small cars from Zhonghua, Geely Global Eagle, Chery Kerry and Suzuki have significantly increased with the reason closely related to their rapid response to the policy. Table 10 shows that four firms that have more than 100% increase in small car sales relative to the large car sales after the policy, while the average treatment effect of this policy is only 16%.

Table 10. Difference-in-Differences Results Depending on Manufacturers

	$treat_j * after_t$
Zhonghua	3.05 (Std.Err 0.044)
Geely Global Eagle	1.15 (0.020)
Chery Kerry	1.05 (0.026)
Suzuki	1.25 (0.017)

I investigate why these four firms perform much better than other firms. Prior to 2009, all of these manufacturers had already begun the production of 1.3L displacement vehicles. In May 2008, China Junjie FRV went on the market with two displacements of 1.3L and 1.5L.

Later on November 6 in 2008, Geely Global Eagle was established and mainly produces clean energy-powered vehicles. At the 2008 Guangzhou Auto Show, the 1.3L Panda was officially launched as the first model under the "Global Eagle" brand.

As for the other two manufacturers, the focus on the small cars began even earlier. Chery-Kerry has launched a 1.3-liter minivan since 2007, while Suzuki has been producing mini-cars since 1955, which 1.3-liter cars are mainly Swift and Antelope series. New models in the series were also launched in 2007 and 2009.

5. CONCLUSION

In this study I investigate the impact of "Automobile Go to Countryside" policy on consumer behavior, especially focusing on changes in car sales. Today, China's economic development is slowing down and is moreover heated by the coronavirus epidemic in early 2020. Driving consumer demand inside China has become an important measure to promote development. Using difference-in-differences research design, I find that, after the implementation of the "Automobile Go to Countryside" policy in 2009, the sales of small cars increased by about 16% compared to the big cars.

Moreover, the growth of car sales is inhibited by high ownership, which also reminds us that the effect of "Automobile Go to Countryside" policy in 2019 may not significantly function. Also, oil prices affect whether consumers will take advantage of the implementation of the policy to purchase cars. More precisely saying, high oil prices could inhibit consumers' desire to buy, which is even more pronounced when oil prices fluctuate drastically. From 2008 to 2010, the four automobile manufacturers named Zhonghua, Geely Global Eagle, Chery Kerry, and Suzuki performed well. They have already started production and commercial deployment before the implementation of the policy, which is especially worthy of learning by the new generation of automobile manufacturers.

This study gives implications on the further exploration of the Chinese auto market. If possible, follow-up research workers could collect data on China's provincial auto sales from 2019 to 2020 to see if the new round of "Automobile Go to Countryside" policy has played a role. At the same time, they can also compare the two policies spanning a decade, or use it as an entry point to study the history of China's economic development. With the advancement of science and technology, China's automobile industry has made great progress. From a more macro perspective, the development of manual driving technology and the layout of new energy vehicles in China can also be the subject of further scientific research.

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